THE VISION FIELDS IN CASES OF INDIRECT OR INCOMPLETE LESIONS OF THE OPTIC SYSTEM.

By Colin K. Russel, B.A., M.D.,

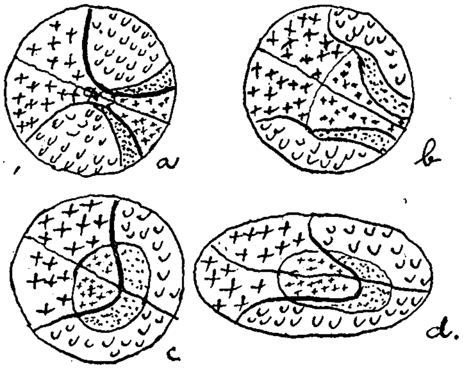
OF MONTREAL,

FORMER HOUSE PHYSICIAN, NATIONAL HOSPITAL FOR PARALYSED AND EPILEPTIC, QUEEN SQUARE, LONDON, ENG.; CLINICAL ASSISTANT IN MEDICINE AND NEUROLOGY, ROYAL VICTORIA HOSPITAL, MONTREAL, CAN.

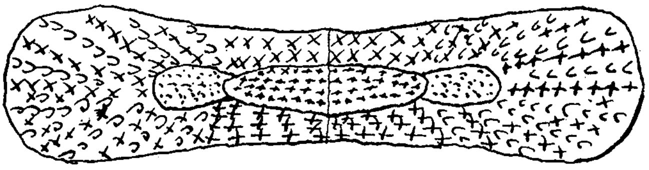
It is a well recognized fact that where intracranial tumors exist causing impairment or loss in the fields of vision, that there is considerable variation according to the site of the lesion and the part of the optic system interfered with. This can be readily seen from the anatomical relations, more especially of the macular fibers, which, in this connection, are of prime importance. In the optic nerve these macular fibers are collected into a circumscribed bundle[1], situated more or less centrally. The fibers of this macular bundle, which later decussate, lie in a wedge-shaped area on the temporal side of the nerve and slightly ventral, while those which are uncrossed lie dorsal and ventral to them. Approaching the chiasma the crossing fibers become gradually still more central, while the uncrossing fibers lie to their temporal side [vide Fig. I.].

Going still more backwards one sees that in the chiasma itself there is a certain amount of rearrangement, but the macular bundles still maintain their individuality and are found to retain their central position. Opinions differ as to whether the uncrossed macular fibers form an individual bundle in the tract, or intermingle with the crossed bundles. Henschen, and the majority of other observers, find that the uncrossed bundle lies above and to the temporal side of the crossed bundle, and maintains this position till it enters into the external geniculate body. Here it breaks up into numerous smaller bundles.

The pulvinar and the anterior corpora quadrigemina hold a very much less important position with regard to vision, in man, than they do in the lower animals, and cases have been reported in which destruction of one or both of these ganglia have caused no hemianopia.[1] So that the external geniculate body is by far the most important, if not the only primary center of vision. Flechsig has shown that in the newborn the fibers from the geniculate body are the only ones in the optic radiations which have their myelin sheath. The arrangement of cells and their relation to the visual fields in this ganglion is obscure. It is possible, as suggested by Henschen from a study of two cases with lesions



Right Optic Nerve. (Diagrammatic.)



e. Diagram of Chiasma.
Fig. 1.

++ Crossed peripheral fibers. ::: ::: Direct macular fibers.
+ + Crossed macular fibers. u u Direct peripheral fibers
Temporal side to right.
Nasal side to left.
a. Nerve at exit from optic globe.
b. Nerve. More central section.
c. Nerve section of intraorbital portion.
d. Nerve. Intermediate section anterior to chiasma (from Henschen).

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[1] Sinkler: Neur. Centralblat, 1893, p. 300; "Tumor of the Thalamus without Hemianopia." Eisenlohr: Ibid. 1892, p. 149; "Destruction of the Pulvinar on Both Sides Without Loss of Vision." He says vision was not appreciably affected. Henschen: "Path. des Gebirns." Vol. III, 8th case and 17th; hemorrhage into the pulvinar; vision normal. Miura of Tokio (quoted by Henschen in "Le centre cortical de la vision"); Thalamus and anterior corpora quadrigemina involved in gliomatous neoplasm, with only a little irregular concentric limitation of vision fields. Eisenlohr: Quoted by Henschen in "La centre de la vision;" Bullet wound causing destruction of anterior corpora quadrigemina, with no loss of vision, merely inactive pupil. von Monakow: Similar case.

affecting the dorsal part of these bodies, that the cells in the dorsal part are in relation to the inferior portion of the visual field.

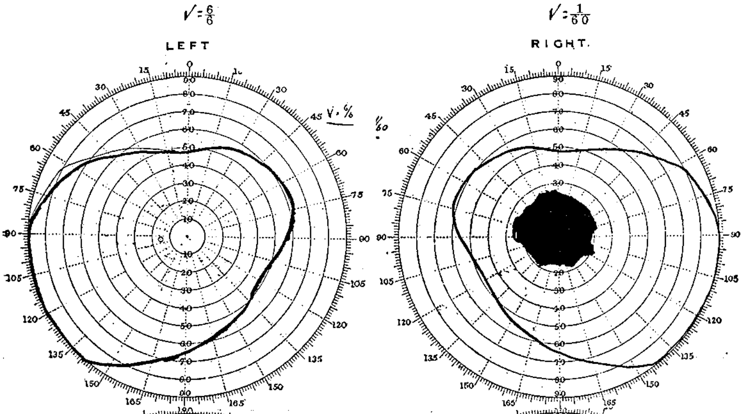
The same author, and von Monakow also, has described in cases of atrophy of one optic nerve, crossed and uncrossed fibers going to one part of this ganglion. This would suggest that the corresponding parts of the two retinæ are connected with the same part of the geniculate body.

The question of the extent of cortical representation of the retina in the occipital lobe is hard to answer. If we consider the blood supply of the part we shall see the difficulty. The posterior cerebral artery, a branch of the basilar, supplies the medial surface of the occipital lobe, giving off three branches: (a) To the parieto-occipital fissure; (b) to the calcarine fissure, and (c) to the cuneus. The branch to the calcarine fissure sends in a branch to the optic radiations so that any lesion interfering directly or indirectly with the blood supply affects not only the cortex but the optic radiations as well.

Ferrier, who has done much in the study of cerebral localization of physiological functions, in the first place started experimentors on the wrong track,—just as Charcot led the clinicians astray. He placed the center of vision in the angular gyrus. Later, with Yeo, he extended this to the occipital lobe. Munk established it definitely in the occipital lobe, and von Monakow by means of the method of consecutive degeneration, placed the center of vision in the territory of the calcarine fissure and the two adjacent convolutions (cuneus and lingual); and later extended it on the external surface as far as the angular gyrus. Henschen limits it to the calcarine fissure. Campbell, from his recent histological investigations, is convinced that two definite and distinct areas can be mapped out in the occipital lobe, and that these two fields have different physiological functions to perform—the one specialized for the primary reception of visual sensations, the other constituted for the final elaboration and interpretation of these sensations. The first he terms, "the visuo-sensory center" and locates it in both lips of the calcarine fissure. The other field, which he has named the "visuo-psychic center," invests this and extends from the parieto-occipital fissure on the medial surface, including the whole cuneus and posterior part of the lingual and fusiform cortex, and extends on the external surface of the occipital lobe as far forward as the Ramus Occipitalis Transversus (the homologue of the "Affen Spalte").

Fig. 2.

Fig. 2. Fields for white showing central scotoma.



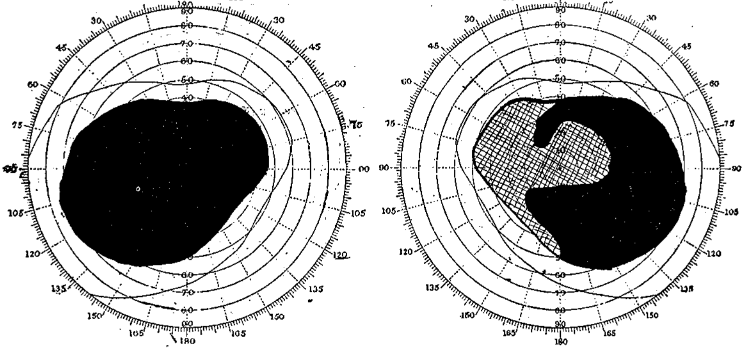


Fig. 2A.

Fig. 2A. Fields for red, showing scotoma central and to nasal side. Test objects used measure 1.0 cm. square.

Acuity of vision, left=$\frac{6}{6}$ Right=$\frac{1}{60}$

Henschen[2] has suggested, from clinical and microscopical research that those fibers which end in the upper lip of the calcarine fissure stand in relation to the upper homonymous quadrants of the retinæ, and those to the lower lip of the fissure correspond to the lower homonymous quadrants. In the optic radiations the same thing holds good, as I think Beevor and Collier's[3] case shows, in which with quadrantic hemianopia in the left upper *fields* there was degeneration in the ventral part of the right radiations, i. e., that the upper part of the radiations corresponds to the upper part of the retinæ.

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[2] "Projection de la retina pour la corticaleté calcarine," Paris, '03, p. 12.

These anatomical relations bear a most important relation to clinical facts, more especially as regards cerebral localization. With incomplete or indirect lesions of the optic system the *fields and the acuity of vision vary very materially, according as the lesion affects the optic nerve, the tract, or the radiations.* The reason for this variation is obvious and depends on the *position of the macular fibers,*—subserving, as they do, the higher physiological function of central vision, they are more highly developed; added to this, their more delicate histological structure and their position in the optic nerve and tract, *indirect or incomplete lesion of these parts gives rise to impairment in acuity or loss of central vision, while lesions posterior to this where the macular fibers are no longer grouped together, but form rather a physiological projection, cause a quadrantic or a hemianopic loss with less impairment in acuity of central vision.*

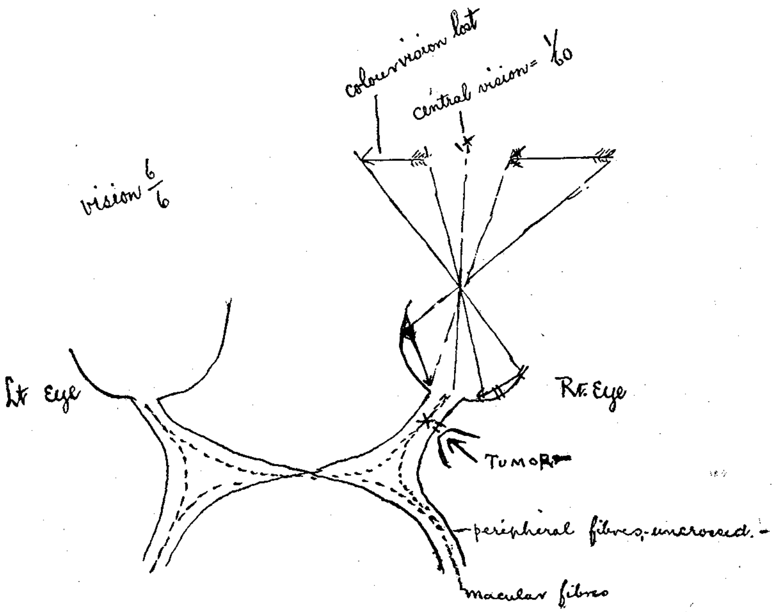

Fig. 2B.

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[3] Brain, Summer, 1904, p. 153.

CASE I. *Optic Nerve Lesion; direct or indirect pressure.* A. F., male, aged 36, clerk, was admitted March 29th, 1905, to the National Hospital under Sir William Gowers, complaining of headache, fits, and mental change. For five years the sight in the right eye had gradually been getting bad, and for nine months he had suffered from headache, left-sided fits, and some mental deterioration.

On examination, smell was lost in the right nostril and normal in the left. The vision was, R.=1-60th, L.=6-6. *Optic discs= R.,* margins clear cut with considerable atrophic cupping. The lamina cribrosa was visible over a large area; the inner margin of the disc was opaque dirty gray; veins of good size, arteries small.

L. Normal.

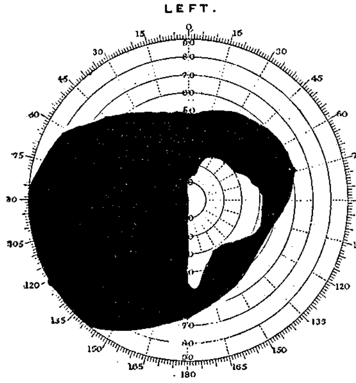


Fig. 3A.
Acuity of vision=$\frac{6}{30}$

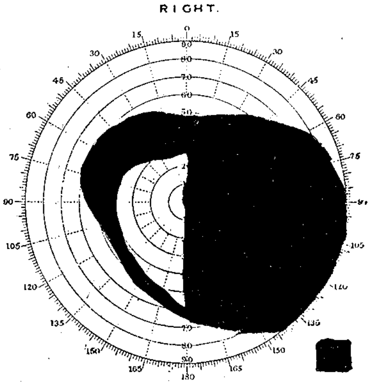


Fig. 3B.
Macular vision=nil.

Pupils: R. Dilated slightly compared to left; *L.* reacted well. *R.* poorly and dilated again quickly.

The *vision fields,* Fig. 2, shows the left to be normal, while in the right there is a central scotoma for white. To red and green the scotoma extended into the nasal part of the field as well—Fig. 2A.

Taken in conjunction with the right-sided anosmia and the other symptoms, the defect in the right field division makes it more than probable that there was a tumor in the posterior part of the anterior fossa causing pressure on the optic nerve from the temporal side—the macular fibers, although more central, suffer first on account of their more highly organized structure—shown by the central scotoma for white. Color vision being a later acquisition and a higher physiological function, is still more easily damaged and its paths even outside the macular bundle on the temporal side of the nerve, in the direct line of pressure, are interfered with causing the loss of color vision to extend into the nasal field as well—(vide Fig. 2B).

Cases 2 and 3. *Chiasmal Lesions.* In these cases one finds in the *visual fields*: (1) Very little escape round the fixation point (vide Fig. 3A); or (2) overspread of fixation points (vide Fig. 3B); or (3) blindness in one eye. In Case 2, I was also able to ascertain from Dr. Atley, who attended this patient, that six months prior to his admission to the hospital he had definite bitemporal hemianopia for red, more marked in the right field than in the left, while the fields for white were practically unimpaired.

Case 2. A. C., male, aged 26, caterer, was admitted to the National Hospital July 10th, 1905, under Dr. C. E. Beevor, complaining of headache, vomiting, mental change, and dimness of vision. The headache started about two years before admission, and the eyesight had been getting bad since about six months, especially in the right eye.

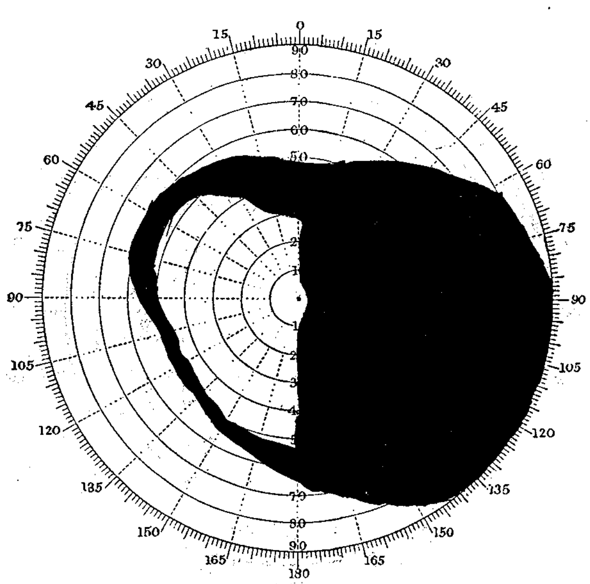


Fig. 4.

Acuity of visoin, R=$\frac{6}{36}$ L.=nil.

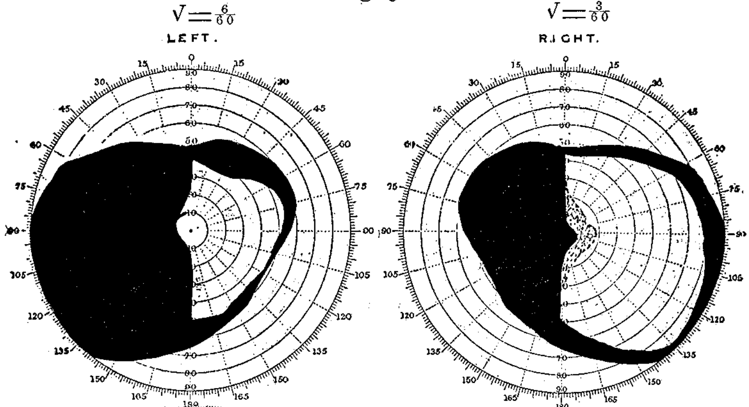
On examination by Dr. Gunn, both discs were pale, the left decidedly so, and both had an opaque appearance as if at one time they had been involved in a subacute papillitis. There was a little connective tissue in the center of the right disc.

Vision fields (vide Fig. 3) shows definite bitemporal hemianopia involving the fixation point of the right, sparing it to a certain extent in the left. Acuity, L.=6-30, R.=macular vision nil.

Pupils: R. larger than L., and shows marked ectopia pupillæ, being transposed in an upward and inward direction,—both react to light and accommodation, left better than right.

CASE 3. W. K., male, aged 45, grocer, was admitted to the hospital under Dr. Risien Russell on Nov. 15th, 1904, complaining of loss of eyesight and inability to open left eye. The patient has had ptosis of the left eyelid for 2½ years, gradually increasing and associated with diplopia on looking to the right, with diminution in vision in the left eye for the past year and a half. One year ago the acuity of vision was tested and showed 6-6 in right eye, with only ability to count fingers in the left. For the past four months the patient has noticed that he cannot see objects to his right side.

Fig. 5A.



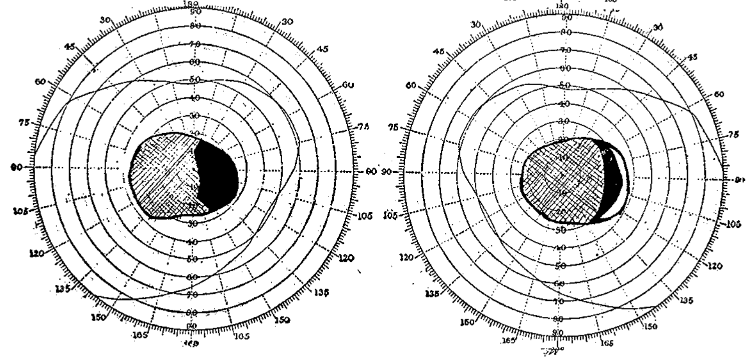


Fig. 5B.

A. White fields.
B. Red fields, showing defect to the left.
Acuity of vision L.$=\frac{3}{60}$ R.$=\frac{3}{30}$

On admission, he has double optic atrophy. The acuity of vision for the right is 6-36, the left, nil. The right field shows loss on temporal side (vide Fig 4).

There was complete third nerve paralysis on the left side with ptosis and dilated pupil. He complained also of severe paroxysmal pain over the left trigeminal region with hypersensitiveness to painful and tactile stimuli.

In both these cases, to summarize, there was a tumor of the pituitary gland (removed at operation by Sir Victor Horsley). In the one case more extensive to the right side, in the other to the left, as shown by the associated oculomotor paralysis. In each case we find macular vision is nil on the side to which the growth is more extensive, while in the other eye, though macular vision is decidedly impaired, it is still fairly good, 6-30 in one case and 6-36 in the other. This can be accounted for by the uncrossed macular bundle being spared, while the impairment of vision is due to the destruction of the crossing macular bundle.

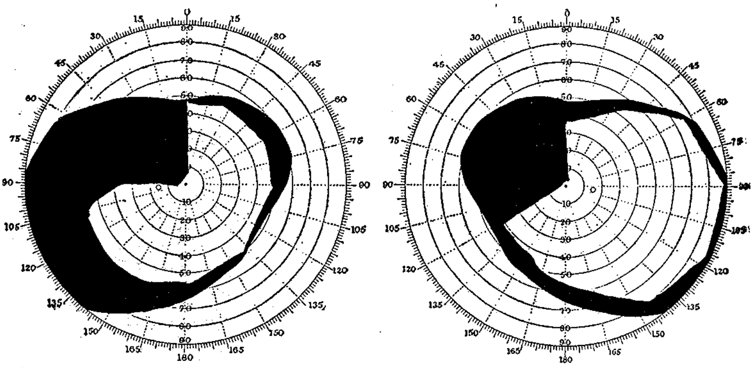


Fig. 6.

Case 4. *Pressure on right optic nerve; right side of chiasma and right optic tract.*

W. A., male, aged 37, clerk, was admitted to the hospital Jan. 27th, 1905, under Sir William Gowers, complaining of headache, loss of vision, and fits. His eyesight had been getting bad for the last five months, and he noticed that he could not see to the left.

On examination the right optic disc showed reddening of the upper edge, the left subacute optic neuritis with +2 diopters swelling.

The fields of vision showed left homonymous hemianopia with very great impairment of macular vision in the right eye, less in the left, the acuity being, right, 3-60; left, 6-60 (vide Fig. 5). Here the position of the tumor was verified at autopsy.

In this greater impairment of macular vision, lesions of the optic tract differ from what one sees in lesions of the optic radiations and cortex. In these latter situations, with their bilateral innervation and wide representation in each cortex, the macular fibers are seldom sufficiently damaged to cause much impairment in acuity of central vision, while in the former situation their position exposes them to greater dangers.

CASE 5. *Incomplete lesions of the optic radiations.*

E. M., male, aged 37, tobacconist, was admitted on the 4th of July, 1904, under Dr. C. E. Beevor, complaining of fits and disturbance of vision. His past history was negative, and he denied veneral disease.

Two years ago he had a general convulsive attack, with loss of consciousness, coming on without warning and leaving no weakness of the extremities on either side. Ten months ago he had the first of a series of attacks, which he describes as visual delusions,—he would be looking at some object when he would become aware that he was unable to see the whole of it. On one occasion, when looking at a tray with two wineglasses, he found to his surprise that he could only see one. Such attacks lasted only a few minutes. He had four in all. Two months ago he suddenly became unconscious while riding a bicycle and fell, but soon regained consciousness and was not paralyzed. He had some sensations of tingling, starting in the left foot and traveling up the leg to the arm. He had never suffered from headaches or noticed any weakness or giddiness.

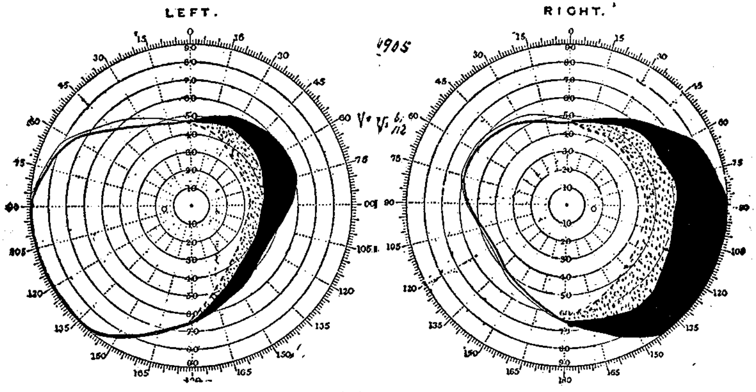


Fig. 7.

Acuity of vision, R.$=\frac{6}{12}$ L.$=\frac{6}{12}$

On examination, the optic discs were normal, the fields showed homonymous quadrantic defects, as in charts (vide Fig. 6). The pupils were equal and reacted to light and accommodation, the right better than the left. The cranial nerves were otherwise negative.

Motor System: There was some very slight relative weakness of the left side. The reflexes were normal and equal on the two sides.

He was thought to have a vascular lesion of the right lobus cuneus and was kept under observation outside the hospital. He was readmitted in December, 1904, with definite signs of cerebral tumor and more advanced defects in the fields of vision.

At operation, the postcentral convolutions were found flattened, and on being incised a cystic tumor was found extending downwards and inwards; this was removed. When the patient was sufficiently recovered, he was found to have complete hemianopia, sparing macular vision in both eyes.

Case 6. *Incomplete lesions of optic radiations.*

E. M., male, aged 39, carman, admitted May 31st, 1904, under Sir William Gowers.

The patient had a superficial tumor removed from the left supramarginal region by Sir Victor Horsley, and on recovery was found to have limitations of both fields to the right, as seen in Fig. 7. The acuity was 6-12 in either eye.

In Case 5 it seems probable that the tumor in growing impinged first on the lower fibers of the radiations supplying the lower quadrants of the retinæ and caused loss of vision in the upper homonymous quadrants of the fields,—according to Henschen's localization of the fibers already quoted.

While in Case 6 the lesion in the supramarginal region would involve the radiations in their lateral aspect and damage some fibers to the upper and some to the lower part of the retinæ, thus accounting for the homonymous constriction of the fields.

In conclusion, my best thanks are due to the members of the Visiting Staff of the Hospital, who have so kindly permitted me to use their cases.